

FORM PCT 1390
REV. 5/93

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NO.
BÖHRINGER ET AL.-1 (PCT)TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)

09/806793

INTERNATIONAL APPLICATION NO.
PCT/EP99/07345INTERNATIONAL FILING DATE
4 OCTOBER 1999PRIORITY DATE CLAIMED
6 OCTOBER 1998

TITLE OF INVENTION

NETWORK FOR DATA TRANSMISSION (As Amended)

APPLICANT(S) FOR DO/EO/US

HARALD BÖHRINGER ET AL.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371 (f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(I).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau)
 - b. ☐ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has **NOT** expired.
 - d. ☐ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:

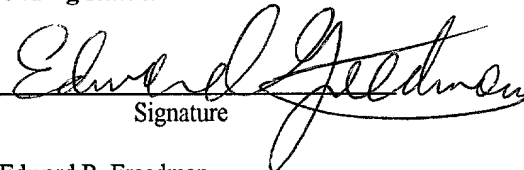
PCT/ISA/210 - Int'l. Search Report (English)
2 Sheets of Formal DrawingsApplicant Claims Priority under 35 U.S.C. §119 of German Application No. 198 45 876.2 filed October 6, 1998.
Applicant Claims Priority under 35 U.S.C. §120 of: PCT/EP99/07345 filed October 4, 1999.

APPLICATION NO. (if known, see 37 CFR 1.5) 09/806793				INTERNATIONAL APPLICATION NO PCT/EP99/07345	ATTORNEY'S DOCKET NO. BOHRINGER ET AL.-1
<input checked="" type="checkbox"/> The following fees are submitted: Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO.....\$860.00 International preliminary examination fee paid to USPTO (37 CFR 1.482)\$690.00 Neither international preliminary examination fee paid (37 CFR 1.82) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO.....\$1,000.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4).....\$100.00 ENTER APPROPRIATE BASIC FEE AMOUNT =				CALCULATIONS	PTO USE ONLY
				\$ 860.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than ____ 20 ____ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).					
Claims	Number Filed	Number Extra	Rate		
Total Claims	10 - 20 =	- 0 -	X \$18.00	\$	
Independent Claims	1 - 3 =	- 0 -	X \$80.00	\$	
Multiple dependent claim(s) (if applicable)			+ \$270.00	\$	
TOTAL OF ABOVE CALCULATIONS =				\$ 860.00	
Reduction by 1/2 for Small Entity status.				\$ 430.00	
SUBTOTAL =				\$ 430.00	
Processing fee of \$130.00 for furnishing the English translation later than ____ 20 ____ 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$	
TOTAL NATIONAL FEE =				\$ 430.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property +				See cover sheet attached to assign \$ to be charged to Deposit Acct	
TOTAL FEES ENCLOSED =				\$ 430.00	
				Amount to be:	
				refunded	\$
				charged	\$

- ☒ Applicant claims Small Entity status.
- a. ☒ A check in the amount of \$ 430.00 to cover the above fees is enclosed.
- b. ☐ Please charge my Deposit Account No. 03-2468 in the amount of \$ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment, to Deposit Account No. 03-2468. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

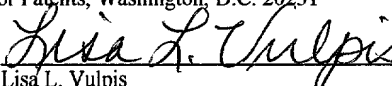
SEND ALL CORRESPONDENCE TO:
 COLLARD & ROE, P.C.
 1077 Northern Boulevard
 Roslyn, New York 11576-1696
 (516) 365-9802


 Signature

Edward R. Freedman
 Reg. No. 26,048

Express Mail No. EL 769 424 581 US
 Date of Deposit April 4, 2001

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10, on the date indicated above, and is addressed to the Ass't. Commissioner for Patents, Washington, D.C. 20231


 Lisa L. Vulpis

09/806793

JC08 Rec'd PCT/PTO 0 4 APR 2001

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANTS: HARALD BÖHRINGER ET AL. - 1 (PCT)
PCT NO.: PCT/EP99/07345
FILED: OCTOBER 4, 1999
TITLE: NETWORK FOR DATA TRANSMISSION (As Amended)

PRELIMINARY AMENDMENT

BOX PCT

Ass't. Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Preliminary to the initial Office Action, please amend the
above-identified application as follows:

IN THE TITLE:

Please amend the title to read --NETWORK FOR DATA
TRANSMISSION--.

IN THE ABSTRACT:

Please add the Abstract of the Disclosure, attached as
Exhibit A, as a separate page.

IN THE SPECIFICATION:

Please delete Pages 1-4 and substitute the attached Pages 1,
1a, 1b, 2, 3 and 4, attached hereto as Exhibit B.

IN THE CLAIMS:

Please cancel claims 1-11 and replace them with new claims 12-21 as follows:

--12. A network for data transmission with modules (3,9) linked for data exchange, as well as hub switches (1), each with several terminals and assigned and/or integrated memory array, with each hub switch connecting its terminals in pairs while disconnecting from all other terminals and/or temporarily storing the data packets forwarded via the terminals separately and only forwarding them to the respective address terminal when it is available for data reception and/or can be disconnected, characterized in that in a process control with several programmable controllers (3) linked through the hub switches (1), each including a central processing unit (6) and slave processors (7), each programmable controller is assigned a hub switch with separate terminals for the slave processors and central processing unit of the respective programmable controller and each slave processor can exchange data with any arbitrary module while circumventing its assigned central processing unit.

13. A network according to claim 12, characterized in that connections between the terminals of a hub switch (1, 1') and/or relays of saved data to one of the terminals occur according to presettable priorities.

14. A network according to claim 12, characterized in that at least one terminal on at least one hub switch (1) is connected as a programming input (4).

15. A network according to claim 12, characterized in that the hub switches (1, 1') are linked and/or networked with one another via fiberoptic cable (2).

16. A network according to claim 12, characterized in that the hub switches (1, 1') are at least partially linked and/or networked with one another via electrical data lines.

17. A network according to claim 12, characterized in that alternatively to the hub switches (1, 1') and/or on a terminal of at least one hub switch (1'), a bus system (9) is provided.

18. A network according to claim 17, characterized in that the bus system (9) links together access control units (11) monitored by a transmission authority control (12), via which the bus (10) of the previously mentioned system (9) is connected with the assigned terminal of the hub switch (1') and/or with a central processing unit (6), with slave processors (7) and/or with a programming device (4), with the transmission authority control (12) exclusively switching the transmission authority of the access control units (11) cyclically and/or according to presettable priority.

19. A network according to claim 18, characterized in that each bus system (9) has its own transmission authority control (12).

20. A network for data transmission with modules (3, 9) linked for data exchange, particularly according to claim 12, characterized in that in a process control with several linked programmable controllers, each including a central processing unit (6) and several slave processors (7), at least one controller has its central processor (6) and slave processors (7) connected with one another and with the network via a bus system (9), which links access control units (11) monitored by a transmission authority control (12), via which the bus (10) of the bus system (9) is connected with the processors (6, 7) and/or with the network, with the transmission authority control (12) exclusively switching the transmission authority of the access control units (11) cyclically and/or according to presettable priority.

21. A network according to claim 18, characterized in that the access control units (11) temporarily save transmission data of the assigned data modules until transmission authority is received.--

REMARKS

By this Preliminary Amendment, the application has been amended to conform with U.S. practice, pages 1-4 have been substituted by new pages 1, 1a, 1b, 2, 3 and 4, claims 1-11 have been replaced by new claims 12-21 and an Abstract has been provided. No new matter has been introduced. Entry of this amendment is respectfully requested.

Respectfully submitted,
HARALD BÖHRINGER ET AL.-1 (PCT)



Allison C. Collard, Reg.No. 22,532
Edward R. Freedman, Reg.No. 26,048
Attorneys for Applicants

COLLARD & ROE, P.C.
1077 Northern Boulevard
Roslyn, New York 11576
(516) 365-9802
ERF:jc

Express Mail No. EL 769 424 581 US
Date of Deposit April 4, 2001

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. § 1.10, on the date indicated above, and is addressed to the Ass't. Commissioner for Patents, Washington, D.C. 20231.


Lisa L. Vulpis

EXHIBIT A

EXHIBIT A

ABSTRACT OF THE DISCLOSURE

Novel configuration preventing collision of data transmissions on data transmission paths. Repeated transmission attempts after said collisions thus become unnecessary. Transmission capacity of the data network can be used optimally resulting in considerably faster control.

1044-625060

09/806793

JC08 Rec'd PCT/PTO 0 4 APR 2001

EXHIBIT B

09/806793

09/21/00

PCT/EP99/07345

DESCPAMD

NETWORK FOR DATA TRANSMISSIONCROSS REFERENCE TO RELATED APPLICATIONS

Applicants claim priority under 35 U.S.C. §119 of German Application No. 198 45 876.2 filed October 6, 1998. Applicants also claim priority under 35 U.S.C. §120 of PCT/EP99/07345 filed October 4, 1999. The international application under PCT article 21(2) was not published in English.

The invention concerns a network for data transmission with modules linked together for data exchange and hub switches, each with several terminals and assigned and/or integrated memory array, with each hub switch connecting its terminals in pairs while disconnecting from all other terminals and/or temporarily storing the data packets forwarded via the terminals separately and only forwarding them to the respective address terminal when it is available for data reception and/or can be disconnected.

These types of networks are known in principle in the field of communication networks, cf., for example, the US patent specifications 5,544,163, 5,781,530, and 5,790,786.

However, this technology has not yet gained favor in the control of industrial processes.

Rather, in typical process controls, the modules of the control are linked together via a bus, whereby it is provided that the individual modules transmit the data received by them, which is to be forwarded to other modules, at arbitrary times, determined without regularity. The data exchange can, however, only function if the data of one single module at a time is transmitted on the bus. If two or more data modules transmit their data

[illegible]

cannot be interrupted during the transmission by another data module beginning to transmit. In widespread process controls, colliding data transmissions occur comparatively frequently, with the consequence that the data exchange can be delayed significantly and/or to such a degree that an optimal control of the respective process is no longer possible and/or is no longer possible with the desired rapidity.

It is therefore the task of the invention to create a network suitable for the control of industrial processes which makes possible a data exchange having good reproducibility in regard to the time required.

This task is solved according to the invention in that in a process control with several programmable controllers linked through the hub switches, each including a central processing unit and slave processors, each programmable controller is assigned a hub switch with separate terminals for the slave processors and the central processing unit of the respective programmable controller, and each slave processor can exchange data with arbitrary modules while circumventing its assigned central processing unit.

These types of hub switches are commercially available as, for example, "Ethernet switches" and have a complete transmitter and receiver for each terminal, so that each terminal is continuously available for the transmission or reception of data, and data reaching the terminal is continuously saved or, if another terminal is idle, can be forwarded to this other terminal.

Additionally or alternatively, a bus can be provided which links together access control units (MAC, media access controller), monitored by a transmission control, via which the bus is connected with at least one assigned terminal of a hub switch and/or a central processing unit (CPU), slave

processors, and/or a programming device, with the transmission control exclusively switches the transmission authority of the access control units cyclically and/or according to presettable priority.

The invention is based on the general idea of preventing colliding data transmissions in a data line through a particular physical structure of the process control and/or through control of the data exchange. Incalculable delay times when accessing a bus and/or a data line are thereby prevented from occurring and the time needed for a data exchange can be calculated exactly and/or within very narrow boundaries.

The linked hub switches subdivide the data transmission chain they form into a number of sections which are, on one hand, available for simultaneously performed data transmissions which are independent of one another, and, on the other hand, with appropriate switching of the hub switches, can form one single continuous data transmission line.

A particular advantage of the hub switches is that they offer the possibility that, in principle, a terminal can be connected to each hub switch as a programming input. On one hand, this offers the advantage of decentralized programming. On the other hand, it is advantageous that when programming the data modules connected to the respective hub switch, the line system linked with the hub switches does not have to be stressed. Rather, the terminal of a hub switch connected as a programming input can communicate internally via the hub switch with its other terminals and thereby with the data modules coupled to them.

The bus and/or the buses with transmission control are advantageously provided for partial systems of the process control and are each assigned a terminal of a hub switch.

The advantage is thereby attained that the hub switch and/or the hub switch system can be conceived with relatively few terminals, because the previously mentioned bus "multiplies" the hub switch terminal assigned to it according to the idle access control units of the respective bus available.

This type of bus system with transmission control does typically have a lower performance capacity than a hub switch system, because each bus forms a unit which cannot be subdivided into subsegments and is only available for one data transmission to or from a data module coupled to the bus at a time. Nonetheless, such a bus system is often completely sufficient for subsystems, particularly for those systems which only have a comparatively small requirement for communication with other subsystems of the process control and, correspondingly, only slightly load the hub switch system during operation of the process control.

With the combination of the hub switch system with bus systems monitored through transmission control, consideration is advantageously taken of the fact that a process control often must link partial systems which are widely spatially separated, and which, on their part, consist of comparatively closely neighboring modules. The closely neighboring modules can then be linked together through the comparatively economical bus systems with typical transmission technology, while the hub switches communicate with one another via optical fibers or other line systems which are conceived for data transmission over large distances and are correspondingly more expensive.

Each hub switch and each bus with transmission control offers, in principally the same way, the possibility of linking the central processor of a programmable controller with assigned slave processors and/or slave units, and doing so in such a way that the slave processors and/or slave units can, if necessary, exchange data with arbitrary data modules of the process control while circumventing the central processor.

On one hand, an appreciable load reduction of the central processor is thereby made possible. On the other hand, the necessary data exchange can be significantly accelerated. Furthermore, the respective central processor can process the tasks incumbent to it faster, without being "disturbed" by data exchange between a slave processor or similar device assigned to it and other parts of the process control.

2/PRTS

09/806793

JG08 Rec'd PCT/PTC 04 APR 2001

PCT/EP/99/07345

WO 00/20935

PROCESS CONTROL

The invention concerns a process control with linked data modules, particularly programmable controllers.

In typical process controls, the data modules are linked via a bus. It is hereby provided that the individual data modules transmit the data to be forwarded to other data modules at arbitrary times which are determined without regularity. The data exchange can, however, only function if the data of one individual data module at a time is transmitted on the bus. If two or more data modules transmit their data simultaneously, each of these data modules immediately ends its data transmission and repeats the respective data transmission after a period of time determined by random generation. In this way, the previously mentioned data modules can, as a rule, be prevented through probability from again simultaneously attempting to transmit. It is also provided in current systems that a data module only begins to transmit if the bus is idle, i.e. no data transmission of another data module is detectable. In this way, it is ensured that a data transmission initiated by a data module cannot be interrupted during the transmission by another data module beginning to transmit.

In widespread process controls, colliding data transmissions occur comparatively frequently, with the consequence that the data exchange can be delayed significantly and/or to such a degree that an optimal control of the respective process is no longer possible and/or is no longer possible with the desired rapidity.

It is therefore the task of the invention to create a process control which makes possible a data exchange having good reproducibility in regard to the time required.

This task is solved according to the invention by a chain of hub switches, each with several terminals and an assigned memory array, with each hub switch connecting its terminals two at a time while disconnecting all remaining terminals and/or temporarily storing the data packets forwarded via the terminals separately and forwarding them to the currently addressed terminal only when it is available for data reception.

These types of hub switches are commercially available as, for example, "Ethernet switches" and have a complete transmitter and receiver for each terminal, so that each terminal is continuously available for the transmission or reception of data, and data of reaching the terminal is continuously stored or, if another terminal is idle, can be forwarded to this other terminal.

Additionally or alternatively, a bus can be provided which links together access control units (MAC; media access controllers), monitored by a transmission control, via which the bus is connected with at least one assigned terminal of a hub switch and/or with data modules, particularly a central processing unit (CPU), as well as slave processors, with the transmission control exclusively switching the transmission authority of the access control units cyclically and/or according to presettable priority.

The invention is based on the general idea of preventing colliding data transmissions in a data line through a particular physical structure of the process control and/or through control of the data exchange. Incalculable delay times when accessing a bus and/or a data line are thereby prevented from occurring and the time needed for a data exchange can be calculated exactly and/or within very narrow boundaries.

The linked hub switches subdivide the data transmission chain they form into a number of sections which are, on one hand, available for simultaneously performed data transmissions which are independent of one another, and, on the other hand, with appropriate switching of the hub switches, can form one single continuous data transmission line.

A particular advantage of the hub switches is that they offer the possibility that, in principle, a terminal can be connected to each hub switch as a programming input. On one hand, this offers the advantage of decentralized programming. On the other hand, it is advantageous that the line system linked with the hub switches does not have to be stressed when programming the data modules connected to the respective hub switch. Rather, the terminal of a hub switch connected as a programming input can communicate internally via the hub switch with its other terminals and thereby with the data modules coupled to them.

The bus and/or the buses with transmission control are advantageously provided for partial systems of the process control and are each assigned a terminal of a hub switch.

The advantage is thereby attained that the hub switch and/or the hub switch system can be conceived with relatively few terminals, because the previously mentioned bus "multiplies" the hub switch terminal assigned to it according to the idle access control units available of the respective bus.

This type of bus system with transmission control does typically have a lower performance capacity than a hub switch system, because each bus forms a unit which cannot be subdivided into subsegments and is only available for one data transmission to or from a data module coupled to the bus at a time. Nonetheless, such a bus system is often

completely sufficient for subsystems, particularly for those systems which only have a comparatively small requirement for communication with other subsystems of the process control and, correspondingly, only slightly load the hub switch system during operation of the process control.

With the combination of the hub switch system with bus systems monitored through transmission control, consideration is advantageously taken of the fact that a process control often must network partial systems which are widely spatially separated, and which, on their part, consist of comparatively closely neighboring modules. The closely neighboring modules can then be linked together through the comparatively economical bus systems with typical transmission technology, while the hub switches communicate with one another via optical fibers or other line systems which are conceived for data transmission over large distances and are correspondingly more expensive.

Each hub switch and each bus with transmission control offers, in principally the same way, the possibility of linking the central processor of a programmable controller with assigned slave processors and/or slave units, and doing so in such a way that the slave processors and/or slave units can, if necessary, exchange data with arbitrary data modules of the process control while circumventing the central processor.

On one hand, an appreciable load reduction of the central processor is thereby made possible. On the other hand, the necessary data exchange can be significantly accelerated. Furthermore, the respective central processor can process the tasks incumbent to it faster, without being "disturbed" by data exchange between a slave processor or similar device assigned to it and other parts of the process control.

In the following, reference is made to the claims and to the subsequent description of the drawings in regard to preferred characteristics of the invention, with the aid of which the preferred embodiment variations of the invention will be described in more detail.

These show

Fig. 1 a schematic depiction of a hub switch chain and

Fig. 2 a schematic depiction of a bus system with transmission control.

According to Fig. 1, a number of hub switches 1 are linked together, for example via fiber-optic cable 2. These hub switches 1 have a number of terminals which, on one hand, serve the fiber-optic cable 2 serving to link the hub switches and, on the other hand, serve for the modules of a programmable controller 3 and/or for a programming device 4.

Insofar as the hub switches 1 are provided for other types of signals, optical signals in the present example, than the units to be coupled to the terminals of the hub switches, which could, for example, be provided for processing of electrical signals, appropriate interfaces and/or interface modules 5 are located and/or integrated in the hub switches 1 or the connected modules 6 and 7.

The hub switches 1 can separately store data entering their terminals and relay it via another terminal, which leads to the desired receiver for the data previously mentioned, with this relay only and/or first occurring when the previously mentioned other terminal is idle.

The storage of the data entering via a terminal can, if necessary, be omitted if the other terminal, via which this

data must be relayed, is already idle when the previously mentioned data arrives. In principle, a temporary storage of the data can, however, also be provided in such a case, with the input of the data into the storage and the transmission of the data from the storage able to occur practically simultaneously and a "virtual" direct connection between two terminals of the hub switch created by the storage.

The programmable controller 3 includes, in a basically known way, a central processing unit 6 (CPU), as well as several slave processors 7.

A characteristic of the invention is, thus, that both the processing unit 6 and the slave processors 7 are assigned separate terminals of the hub switch 1 assigned to the respective programmable controller 3. In this way, it is made possible for each slave processor 7 (or another data module of the programmable controller 3) to communicate with, in principle, any arbitrary data module of the entire process control via the assigned hub switch 1 while circumventing the assigned central processing unit 6.

If necessary, the programmable controller can also have a bus 8, via which the central processing unit 6 and the slave processors 7 can communicate with one another while circumventing the assigned hub switch 1.

As is described further below, a collision of data transmissions on the bus 8 can be prevented through transmission control.

In the example of Fig. 1, a hub switch 1' has only comparatively few terminals, in the example depicted three terminals, of which two terminals are, in turn, provided for fiber-optic cable 2 for networking with other hub switches 1 and/or 1', while one terminal is assigned to a

bus system 9 which will be described in the following with reference to Fig. 2.

The bus system 9 of Fig. 2 has a bus 10 which links a number of access control units 11, also called MACs, i.e. media access controllers, with one another. The left access control unit 11 in Fig. 2 hereby serves for connection to the assigned hub switch 1', whereby, if necessary, the interface unit 5 can be provided between this access control unit 11 and the hub switch 1' in order to be able to convert the signals of the hub switch system into the signals of the bus system 9 and vice versa.

The remaining access control units 11 connect the bus 10 with the central processing unit 6 and the slave processors 7 and/or the programming device 4.

A joint transmission authority control 12 is provided for the access control units 11. This control receives, on one hand, ready-for-sending signals via input-side control lines 13 from the access control units 11 when the module assigned to the respective access control unit 11 - hub switch 1', central processing unit 6 and/or slave processor 7 or programming device 4 - wants to send data or appropriate data is saved in the respective access control unit 11. The transmission authority control 12 selectively distributes transmission authorities to the previously mentioned access control units 11 via output-side control lines 14.

Synchronization of the units communicating with the clock generator 15 is ensured through a joint clock generator 15 for all access control units 11 and the transmission authority control 12. It could also, for example, be provided that a transmission authority signal only remains effective for one pulse and/or for a predetermined number of pulses and must then be renewed.

The transmission authority control 12 ensures, through appropriate programming, that data is relayed to the bus 10 only via one single access control unit 11 at a time. Colliding data transmissions are thereby prevented. Correspondingly, the transmission capacity of the bus 10 can be used optimally, without any interference from colliding data transmissions.

As a result, the bus system 9 effectively multiplies the terminals of the hub switch 1' leading to the bus system 9.

It is advantageous in regard to the acquisition costs of the entire process control if the bus system 9 is implemented with typical electrical circuit engineering, while for the hub switch system, fiber-optic technology can be advantageous. The hub switch system then serves for networking over long distances, while the relatively economical bus system can be used for networking over relatively short distances.

The bus 8 in Fig. 1 can also be implemented corresponding to the bus system 9 in Fig. 2, with the difference that the bus 8 typically has no direct connection to the neighboring hub switch 1, but merely serves for internal data communication of the programmable controller 3.

In the example of Fig. 2, however, each system part coupled to the bus 10 can, on one hand, communicate with other system parts coupled to the bus 10, and, on the other hand, can also directly communicate via the hub switch 1' with system parts on other hub switches 1.

For smaller process controls, the entire system can, if necessary, also be implemented according to the bus system 9 of Fig. 2, with the left access control unit 11 then connected with a slave processor 7 or similar device, instead of with the hub switch 1'.

If there is a high potential for electromagnetic interference in the surroundings and/or there are long line paths, the fiber-optic cables 2 are, as a rule, preferred.

CLAIMS

1. A process control with linked data modules, particularly programmable controllers, characterized by a chain of hub switches (1, 1'), each with several terminals and assigned and/or integrated memory array, with each hub switch connecting its terminals in pairs while disconnecting from all other terminals and/or temporarily saving the data packets forwarded via the terminals separately and only forwarding them to the respective address terminal when it is available for data reception and/or can become available.
2. A process control according to claim 1, characterized in that connections between the terminals of a hub switch (1, 1') and/or relays of saved data to one of the terminals occur according to presettable priorities.
3. A process control according to claim 1 or 2, characterized in that at least one terminal on at least one hub switch (1) is connected as a programming input (4).
4. A process control according to one of the claims 1 to 3, characterized in that the terminals of a hub switch (1) lead to further hub switches and a central processing unit (6) and assigned slave processors (7).
5. A process control according to one of the claims 1 to 4, characterized in that the hub switches (1, 1') are linked and/or networked with one another via fiber-optic cable (2).
6. A process control according to one of the claims 1 to 5, characterized in that the hub switches (1, 1') are

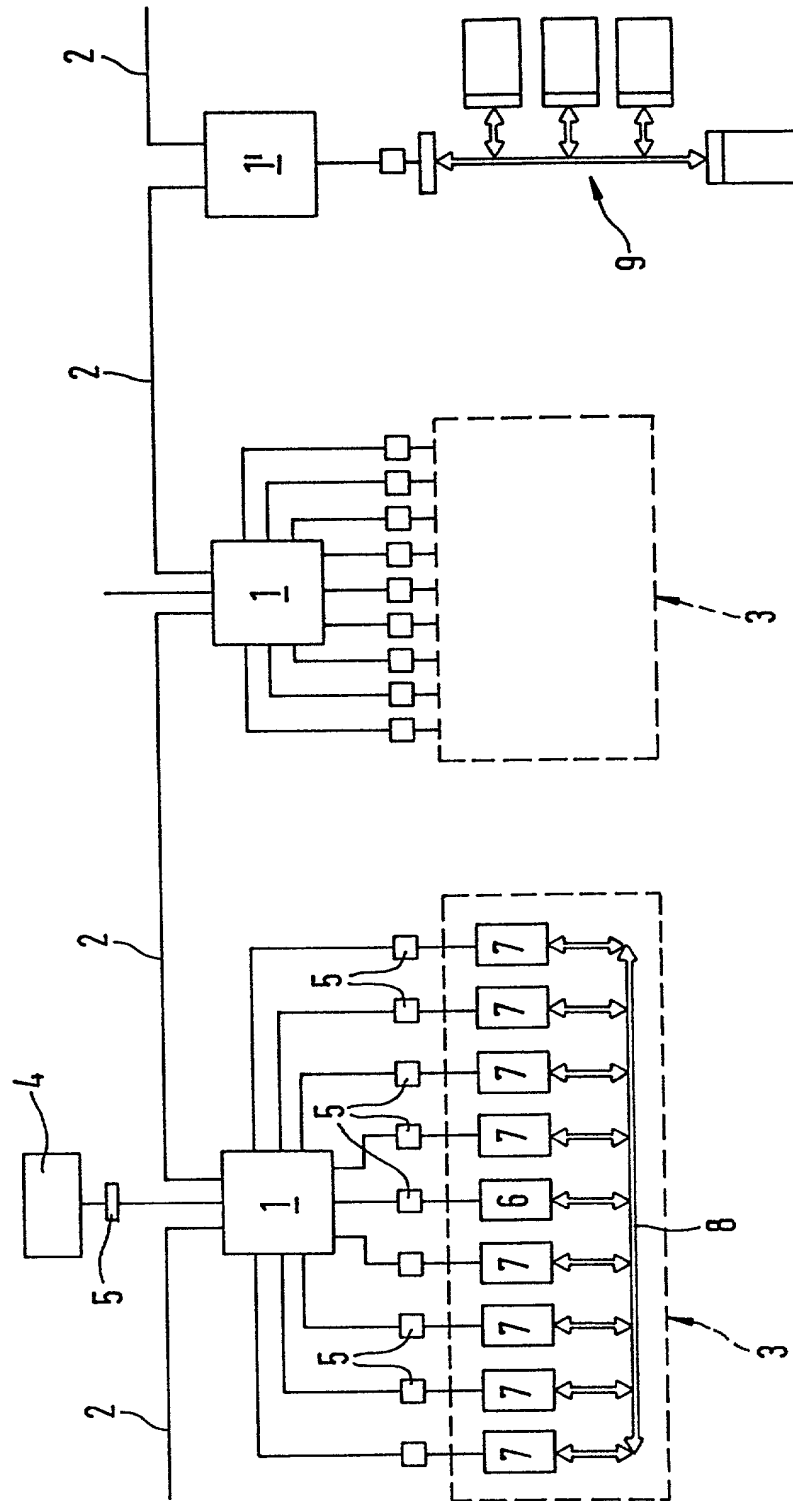
at least partially linked and/or networked with one another via electrical data lines.

7. A process control according to one of the claims 1 to 6, characterized in that alternatively to the hub switches (1, 1') and/or on a terminal of at least one hub switch (1'), a bus system (9) is provided.
8. A process control according to claim 7, characterized in that the bus system (9) links together access control units (11) monitored by a transmission authority control (12), via which the bus (10) of the previously mentioned system (9) is connected with the assigned terminal of the hub switch (1') and/or with data modules, such as a central processing unit (6), slave processors (7) and/or a programming device (4), with the transmission authority control (12) exclusively switching the transmission authority of the access control units (11) cyclically and/or according to presettable priority.
9. A process control according to claim 8, characterized in that each bus system (9) has its own transmission authority control (12).
10. A process control with linked data modules, particularly programmable controllers, particularly according to one of the claims 1 to 9, characterized in that at least a part of the data modules (4, 6, 7) are connected with one another via a bus system (9), which links together access control units (11) monitored by a transmission authority control (12), via which the bus (10) of the bus system (9) receives data from the data modules (4, 6, 7), with the transmission authority control (12) switching the transmission authority of the access control units

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2
--	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	---

- [illegible]

Fig. 1



COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY
(Includes Reference to PCT International Applications)

ATTORNEY'S DOCKET NUMBER
BOEHRINGER ET AL-1 PCT

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

NETWORK FOR DATA TRANSMISSION

the specification of which (check only one item below):

☐ is attached hereto.

☐ was filed as United States application

Serial No. _____

on _____

and was amended

on _____ (if applicable).

☒ was filed as PCT international application

Number PCT/EP99/07345

on 4 OCTOBER 1999

and was amended under PCT Article 19

on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY (if PCT, indicate "PCT")	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 USC 119
GERMANY	198 45 876.2	6 OCTOBER 1998	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY
(Includes Reference to PCT International Applications)

ATTORNEY'S DOCKET NUMBER
BÖHRINGER ET AL-1 PCT

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application Number)

(Filing Date)

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS		STATUS (Check One)		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED
PCT APPLICATIONS DESIGNATING THE U.S.				
PCT APPLICATION NO.	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (if any)		

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (List name and registration numbers): KURT KELMAN, Registration No. 18,628
ALLISON C. COLLARD, Registration No. 22,532; WILLIAM C. COLLARD, Registration No. 38,411
EDWARD R. FREEDMAN, Registration No. 26,048; FREDERICK J. DORCHAK, Registration No. 29,298
ELIZABETH COLLARD RICHTER, Registration No. 35,103 REINE H. GLANZ, Registration No. 46,728

Send Correspondence to: COLLARD & ROE, P.C. Customer No. 25889 Direct Telephone Calls to: (name and telephone number) (516) 365-9802
1077 Northern Boulevard
Roslyn, New York 11576

2	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
0	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
1	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
2	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
0	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
2	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 201

SIGNATURE OF INVENTOR 202

DATE 03/21/2007

DATE 21.03.2007

200 300	2	FULL NAME OF INVENTOR	FAMILY NAME <u>KRAUT</u>	FIRST GIVEN NAME <u>ANDREAS</u>	SECOND GIVEN NAME
	0	RESIDENCE & CITIZENSHIP	CITY <u>LUDWIGSBURG</u>	STATE OR FOREIGN COUNTRY GERMANY <u>DEX</u>	COUNTRY OF CITIZENSHIP GERMANY
	3	POST OFFICE ADDRESS	POST OFFICE ADDRESS <u>REICHERSHALDE 10</u>	CITY <u>D-71642 LUDWIGSBURG</u>	STATE & ZIP CODE/COUNTRY GERMANY
400	2	FULL NAME OF INVENTOR	FAMILY NAME <u>NEHR</u>	FIRST GIVEN NAME <u>WALTER</u>	SECOND GIVEN NAME
	0	RESIDENCE & CITIZENSHIP	CITY <u>STUTTGART</u>	STATE OR FOREIGN COUNTRY GERMANY <u>DEX</u>	COUNTRY OF CITIZENSHIP GERMANY
	4	POST OFFICE ADDRESS	POST OFFICE ADDRESS <u>LEHARSTRASSE 4</u>	CITY <u>D-70195 STUTTGART</u>	STATE & ZIP CODE/COUNTRY GERMANY
500	2	FULL NAME OF INVENTOR	FAMILY NAME <u>SCHWIPS</u>	FIRST GIVEN NAME <u>STEFFEN</u>	SECOND GIVEN NAME
	0	RESIDENCE & CITIZENSHIP	CITY <u>KIRCHBERG AN DER MURR</u>	STATE OR FOREIGN COUNTRY GERMANY <u>DEX</u>	COUNTRY OF CITIZENSHIP GERMANY
	5	POST OFFICE ADDRESS	POST OFFICE ADDRESS <u>HEGELSTRASSE 8</u>	CITY <u>D-71737 KIRCHBERG AN DER MURR</u>	STATE & ZIP CODE/COUNTRY GERMANY
<p>I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.</p>					
SIGNATURE OF INVENTOR 203			SIGNATURE OF INVENTOR 204		
<u>Andreas Kraut</u>			<u>Walter Nehr</u>		
DATE			DATE		
21 March 2001			21 March 2001		
SIGNATURE OF INVENTOR 205					
<u>Steffen Schwips</u>					
DATE					
21 March 2001					